HONEY

Its Value And Use In Popular Cookies[1]

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AN ALMOST endless variety of cookie formulas are available to the baker. Many of these employ honey as an ingredient and are termed "special products." This large number of possible combinations of basic ingredients is a valuable asset to the baker since he is able to produce a variety of cookies to meet the ever changing public demand.

In addition to variety, every baker also is concerned with any possible improvement of those cookies which are generally regarded as standard. Sugar cookies, ginger snaps, vanilla wafers, coconut macaroon chips, fruit bars and brownies are always good sellers and probably make up a very large percentage of cookie production by either large or small producers. It is believed that the use of honey in these cookies could improve them in certain respects. It is important, of course, that the character of these cookies not be changed because, for example, a sugar cookie with different properties is no longer a sugar cookie. The following research has been designed to determine whether cookies could be improved by the addition of honey without affecting their typical characteristics.

[1]Contribution No. 231, Department of Flour and Feed Milling Industries, Kansas Agricultural Experiment Station, Manhattan, Kansas. A report of work done under contract with the U. S. Department of Agriculture and authorized by the Research and Marketing Act of 1946. The contract is being supervised by the Eastern Regional Research Laboratory of the Bureau of Agricultural and Industrial Chemistry.

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Materials and Methods

The effects of honey concentration have been studied on two major classes of cookies. Sugar cookies, ginger snaps and vanilla wafers represent that class of cookies expected to retain dry and somewhat brittle characteristics while coconut macaroon chips, fruit bars, and brownies represent that class of cookies expected to have "chewy" properties.

Arizona alfalfa honey which is a honey of medium color and nearly average chemical properties was used to study the effect of honey concentration on the various cookie types. Fifteen different honeys obtained from widely separated areas within the United States were used to study the effect of honey due to floral source. These honeys, the analyses of which are presented in Table I, represent the extremes in color, flavor, and chemical variation.

The optimum levels of honey that could be employed practically were determined by a series of bakes in which honey concentration was varied, and the properties of flavor, aroma, color, character, and eye appeal were observed. Studies to determine the effect of honey on crumbliness and oxidative rancidity, the rate of color loss with time, as well as differences in color due to sugar type, were also a subject of this study. When it was necessary to make adjustments in the formula to account for moisture in the honey, an average moisture content of 17 per cent was used. Typical commercial bakery formulas were employed (Table II).

Optimum Honey Concentrations

Sugar Cookies

Sugar cookies were made in which 5, 7.5, 10 and 15 percent of the sucrose was replaced with honey. The most outstanding improvement was in the rich golden color attained at the 5 percent level of honey. Higher concentrations of honey caused the cookies to soften on standing. The 10 to 15 percent levels also produced scorched flavors and a very dark color which were probably due to an excess of reducing sugar. There appeared to be no differences in the handling quality of the various doughs.

TABLE I: CHEMICAL ANALYSES OF HONEYS USED IN COOKIE STUDIES

Source	% H_2O	Color[1]	Acidity[2]	% Ash	% N_2	% Dextrose	% Levulose	% Sucrose	L/D[3]
Tupelo	15.9	44	18.7	0.08		28.2	43.8	2.4	1.55
Basswood	18.1	29	10.9	0.10	0.03	35.9	37.0	2.3	1.03
Heartsease	19.4	92	13.4	0.10		33.2	37.2	1.2	1.12
White thistle	15.9	41	25.8	0.12		33.7	39.6	5.0	1.17
Fall flowers	18.0	72	22.1	0.13	0.09	37.5	37.4	1.6	1.00
Mesquite	17.8	24	10.6	0.09		39.3	38.9	1.8	0.99
Cal. Alfalfa	15.6	60	26.5	0.13	0.05	37.5	39.0	4.7	1.04
Eucalyptus	16.6	57	14.2	0.23		36.2	41.6	1.5	1.15
Sw. Clover	16.2	24	9.3	0.04		37.0	41.0	3.0	1.11
Ariz. Alfalfa	16.2	58	15.1	0.16		37.0	41.8	1.5	1.13
Cal. Buckwheat	13.4	56	21.5	0.14	0.07	36.3	42.3	0.9	1.16
Cotton	19.4	51	17.9	0.33		37.0	38.8	1.6	1.05
Orange	16.6	23	9.7	0.06		35.9	39.6	4.0	1.10
White Clover	18.6	37	16.1	0.07	0.06	36.5	38.1	2.6	1.04
Buckwheat	17.5	121	23.0	0.14	0.12	38.8	39.0	1.7	1.01

[1]Mm Pfund.—[2]Ml N/10 NaOH per 100 gm.—[3]Levulose-Dextrose Ratio

Ginger Snaps

The properties of color and flavor of ginger snaps permit the use of higher concentrations of honey. Therefore, 20, 30, 40, and 50 percent honey replaced the invert syrup and portions of the molasses in this series of bakes. The 30 percent level of honey was found to give best results and produced cookies with normal color, but with improved uniformity of surface grain resulting in a more appealing cookie. Concentrations of honey higher than 30 percent caused the cookies to soften. Fifty percent honey caused the same scorched flavor efforts noted in sugar cookies.

Vanilla Wafers

Optimum results were obtained when 5 percent honey replaced invert syrup in vanilla wafers. As in sugar cookies, the quality of the color obtained was considerably improved. Concentrations of 10, 15, and 20 percent honey caused vanilla wafers to soften soon after baking. Their flavor and color also were impaired at the higher levels.

Coconut Macaroon Chips

Macaroon chip, fruit bars, and brownies were expected to tolerate higher concentrations of honey, since the softening effects which were considered adverse in sugar cookies, vanilla wafers and ginger snaps are to be desired in "chewy" cookies. Thus any limitation on honey concentration is more likely to be based on flavor, aroma, and color rather than character effects.

Best results for the macaroon cookies were obtained when honey replaced the invert syrup at the 13.3 percent level. At the time of scoring, both the control cookie and those containing honey seemed identical. However, after being stored a few days those containing honey were found to be more chewy than those made with invert syrup. Higher honey concentrations of 33.3 and 50 percent produced cookies of somewhat darker color than is desired for macaroons.

Fruit Bars

Among all the cookies studied, the most outstanding improvement due too honey was found in fruit bars. Honey was substituted for sucrose in varying amounts up to 66.6 percent and best results were obtained at this maximum level. Higher concentrations could not be used due to the effect of the added moisture on dough handling properties. Dough became increasingly softer as honey was increased since no liquid could be removed to compensate for that added with the honey. The doughs, however, were not excessively soft when 66.6 percent honey was employed. Considerable improvement was noted in the "chewy" character of the cookie as well as in the golden quality of the color obtained. The flavor of honey seemed complimentary to the flavor of the cookies, although they did not possess a definite honey flavor.

Brownies

Brownies are typical of the rich type of cookie ordinarily found in the retail bakery, and are usually quite popular with the consumer. Modifications in the formula included brownies made with 25, 50 and 83.3 percent honey replacing part or all of the glucose, and also part of the sucrose at the highest honey level.

Optimum results were obtained at the 50 per cent level, at which honey entirely replaced glucose. Outstanding improvement was noted in the "chewy" character of the brownies made with honey, while flavor, aroma and appearance were also enhanced. Those containing 83.3 percent honey were inferior due to light color and off flavors.

Storage Studies

Macaroon chips, sugar cookies and vanilla wafers containing the optimum levels of honey were baked and stored in plastic bags in a lighted area at room temperature. Identical treatment was given control cookies. Sugar cookies contained sucrose while vanilla wafers and macaroons contained both invert syrup and sucrose. The development of oxidative rancidity and changes in color were followed for a period of 108 days. Differences in resistance to breakage were determined also after 136 days storage.

Oxidative Rancidity

Perixode determinations[3] were made at frequent intervals during the 108 days of storage. Although slight rancidity was evidenced by the data, this rancidity could not be detected

[3] *Anal. Chem.* 24:527-529 (1952).

TABLE II: COOKIE FORMULAS

	%		%
Sugar Cookies			
Sucrose	58	Whole Egg	8
Shortening	27	$(NH_4)_2CO_3$	1
Salt	1.5	Water	18.5
Dry Skim Milk	2.5	Flour	100
Ginger Snaps			
Sucrose	40	Molasses	45
Shortening	20	Invert Syrup	5
Dry Skim Milk	5	Water	8
Salt	1	$(NH_4)_2CO_3$	1.5
Ginger	1.5	Flour	100
Vanilla Wafers			
Sucrose	30	Whole Egg	30
Powdered Sugar	30	Water	10
Shortening	35	$(NH_4)_2CO_3$	0.5
Invert Syrup	5	Cream of Tartar	0.5
Salt	1	Na_2HCO_3	0.5
Dry Skim Milk	10	Flour	100
		Vanilla	2
Coconut Macaroon Chips			
Brown Sugar	86.6	Invert Syrup	13.3
Shortening	53.3	Water	20
Salt	1.5	Coconut	26.6
Dry Skim Milk	2.5	Flour	100
Baking Powder	1.5	Almond Flavor	0.5
Fruit Bars			
Sucrose	66.6	Salt	1
Brown Sugar	33.3	Raisins	116
Shortening	33.3	Flour	100
Whole Eggs	33.3	Na_2HCO_3	1
		Cinnamon	1
Brownies			
Sucrose	166	Whole Eggs	50
Shortening	83.3	Pecans	66.6
Glucose	50	Flour	100
Cocoa	33.3	Water	16
Salt	4	Vanilla	2

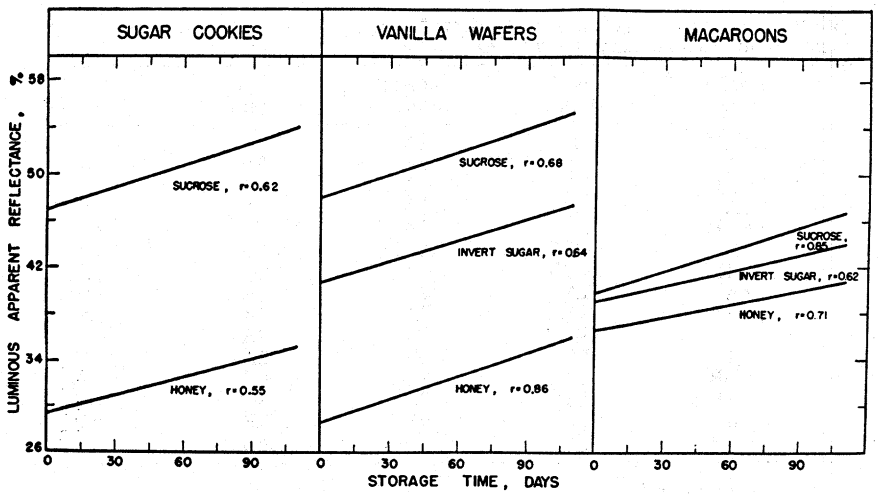

Fig. 1—Rate of color loss vs. sugar type in cookies.

organoleptically. The typical chain-reaction that would be expected to occur with rapid development of oxidative rancidity was not observed. It is apparent, therefore, that the presence of honey at optimum levels does not affect the development of rancidity in cookies.

Color Studies

Color of baked goods can be described in terms of three attributes: hue, value, and chroma[4]. Color measurements were made using a photovolt reflectometer. A survey of the changes in reflectance through amber, blue, and green filters as related to storage time suggests that the only consistent changes occurred in luminous apparent reflectance (Munsell value, lightness, or darkness). Other attributes of color, hue, and chroma, did not change significantly.

The changes in luminous apparent reflectance (Figure 1) shows that all cookies tended to become lighter with storage. This loss of color appears to be directly related to time. Loss of color during storage, however, does not appear to be related to type of cookie or type of sweetening agent, although type of sweetening agent has a pronounced effect on the lightness or darkness of the cookie. These data indicate that honey is useful in developing a brown crust color on cookies and that its effect is normally greater than that due to corresponding concentrations of invert syrup or sucrose.

Crumbliness Studies

After the completion of the 108 day storage tests, ten of each of the remaining cookies were subjected to severe shaking against a screen in a mechanical shaking device. A standard size portion of cookie was cut, weighed and shaken at the rate of 258 times per minute. Sugar cookies and vanilla wafers were shaken for 30 seconds, while macaroons were shaken for two minutes. The piece of cookie remaining intact after shaking was weighed and the percentage loss calculated. The results are presented in Table III.

It is evident from the data in Table III that the use of honey in the different types of cookies affect resistance to breakage. In the most brittle cookie, which is the sugar cookie, honey appeared to have a deleterious effect. In the vanilla wafer, however, results favored honey over both invert syrup and sucrose.

[4]Wilcox, Archer C. and John A. Johnson, "Factors Affecting Color of Baked Products," *Cereal Chem.* 1953 (in press).

TABLE III: EFFECT OF SUGAR TYPE ON CRUMBLINESS OF COOKIES AFTER 136 DAYS STORAGE.

Type Sugar	Type Cookie	Aver. % Loss Due to Breakage
Sucrose	Sugar Cookie	62.4
Honey	Sugar Cookie	72.1
Sucrose	Vanilla Wafers	60.4
Invert (5%)	Vanilla Wafers	59.9
Honey (5%)	Vanilla Wafers	50.6
Sucrose	Coconut Macaroons	68.5
Invert (13.3%)	Coconut Macaroons	65.8
Honey (13.3%)	Coconut Macaroons	43.4

The advantage of using honey was clearly demonstrated in the macaroon. Breakage of honey cookies was reduced by 22 percent under that which resulted when invert syrup was employed, and 25 percent under that resulting when sucrose was employed. It would appear from the results that "chewy" cookies containing the higher percentages of honey would have the advantage of greater breakage resistance.

Effects of Floral Sources of Honey on Cookies

Each of the six kinds of cookies was baked employing optimum levels of all fifteen floral sources of honey. Nine judges were asked to score the cookies indicating their preferences and dislikes. Cookies were judged on the basis of color, flavor, aroma, character, texture and general appeal. The data thus collected is summarized in Table IV. The number and letter "A" or "B" indicate the number of times a cookie was judged superior or inferior respectively, out of a total of nine judgements for that cookie.

It must be concluded from these data (Table IV) that tupelo and eucalyptus honey are of doubtful value in cookies. These honeys affected the flavor of the cookies in such a way that they were judged inferior as often as they were judged superior. The use of heartsease and buckwheat honeys met with unanimous disapproval. Most honeys were considered to be desirable. Honey in general met with the least acceptance in ginger snaps, and with most consistent approval in the chewy types of cookies including macaroons, fruit bars, and brownies. Honey imparted better color to sugar cookies and vanilla wafers, thus adding to eye appeal. The use of honey in ginger snaps seemed to detract from the flavor. Honey in macaroons, fruit bars, and brownies improved the chewy character as well as color and flavor of the cookies.

Summary

The evidence accumulated during the course of this research indicates that honey should meet with favorable acceptance by the baking industry for use in the popular varieties of cookies when used at optimum levels. These include replacement of sucrose or invert syrup in amounts of 5 percent for sugar cookies and vanilla wafers, 30 percent for ginger snaps, 13.3 percent for macaroon chips, 50 percent for brownies and 66.6 percent for fruit bars.

The color of sugar cookies and van-

TABLE IV: SHOWING EFFECT OF HONEYS ON COOKIES*
(Total of nine judgments for each cookie made with each honey.)

Type of Honey	Sugar Cookie	Ginger Snap	Vanilla Wafer	Coconut Macaroon	Fruit Bars	Brownies
Orange	3A	2A-1B	2A	2A	3A	2A
Sweet Clover	3A	2A	2A	2A	5A	4A
Mesquite	3A	3A-1B	3A	3A	4A	3A
Basswood	5A	2A	3A	3A	4A	6A
White Clover	4A	1A-1B	2A	3A	3A	4A
Tupelo	3A-2B	6B	1A-2B	1A-3B	1A-2B	4B
White Thistle	1A	4A-1B	1A-1B	2A	4A	2A
Cotton	3A	4A	2A	2A	4A	3A
Ariz. Alfalfa	2A-1B	3A-1B	3A	2A	3A	2A
Wild Buckwheat	3A	2A	3A	3A	3A	4A
Calif. Alfalfa	2A	3A	1A	2A	2A	2A
Eucalyptus	3A-4B	2A-3B	1A-1B	2A-2B	2A-1B	2A-1B
Fall Flowers	2A	2A-1B	2A	2A	3A	2A-1B
Heartease	8B	9B	4B	9B	9B	9B
Buckwheat	2A-4B	1A-7B	2A	5B	6B	8B

*Where "A" equals number of times cookie was judged superior to control.
Where "B" equals number of times cookie was judged inferior to control.

illa wafers can be improved by the use of honey and all properties of the "chewy" types of cookies are enhanced by honey. The use of heartsease and buckwheat honeys is not recommended. Tupelo and eucalyptus honeys are regarded to be of questionable value because of their effect on consumer acceptability. All other honeys produced cookies of equal or better character and appearance than did sucrose or invert syrup. Variable properties of honey other than flavor and aroma did not in any way affect the production of cookies.

Acknowledgements

Grateful acknowledgment is given to Dr. J. W. White, Jr., Jeanne Maher and the Analytical and Physical Chemistry Division of the Eastern Regional Research Laboratory of the U. S. Department of Agriculture for aid in obtaining certain honeys and chemical analysis of the honeys, and to Mr. De Wayne Barret of the Sioux Honey Association for furnishing several of the honeys.